ability, and an anisotropic exchange spring magnet powder obtained from this magnet can realize a bond magnet and full dense magnet having high ability which have not been obtained from conventional isotropic magnetic powders, therefore, when the anisotropic exchange spring magnet of the present invention is applied to motors, magnetic sensors, rotation sensors, acceleration sensors, torque sensors and the like using magnets, production of smaller and lighter products is promoted, and when this magnet is applied to automobile parts, remarkable improvement in fuel consumption is possible.

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Please delete lines 25-27 on page 17.

IN THE CLAIMS:

Please amend the claims as follows and cancel claim 2.

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1. (Amended) An anisotropic exchange spring magnet powder comprising:

a hard magnetic material phase containing at least one rare earth metal element, a transition metal element, and at least one element selected from the group consisting of boron (B), carbon (C), nitrogen (N) and oxygen (O); and

a soft magnetic material phase containing a transition metal element, and at least one element selected from the group consisting of boron (B), carbon (C), nitrogen (NO and oxygen (O), wherein

said hard magnetic material phase and soft magnetic material phase have crystal particle diameters of 150 nm or less, and wherein

the content of said rare earth metal element is from 2 to 15 atomic %, and the content of at least one element selected from the group consisting of boron (B), carbon (C), nitrogen (N) and oxygen (O) is from 1 to 25 atomic %.

3. (Amended) An anisotropic exchange spring magnet powder comprising:

a hard magnetic material phase containing at least one rare earth metal element
925 selected from the group consisting of neodymium (Nd), praseodymium (Pr) and samarium (Sm), a transition metal element, and at least one element selected from the group consisting of boron (B), carbon (C), nitrogen (N) and oxygen (O); and

a soft magnetic material phase containing a transition metal element, and at least one element selected from the group consisting of boron (B), carbon (C), nitrogen (N) and oxygen (O), and wherein

said hard magnetic material phase and soft magnetic material phase have crystal particle diameters of 150 nm or less, and wherein

the content of said rare earth metal element is from 2 to 15 atomic %, and the content of at least one element selected from the group consisting of boron (B), carbon (C), nitrogen (N) and oxygen (O) is from 1 to 25 atomic %.

5. (Amended) A method of producing an anisotropic exchange spring
926 magnet powder comprising steps of: preparing a crystalline mother material containing a hard magnetic material phase containing a rare earth metal element, a transition metal element, and at least one element selected from the group consisting of boron (B), carbon (C), nitrogen (N) and oxygen (0), and a soft magnetic material phase containing a transition metal element, and at least one element selected from the group consisting of boron (B), carbon (C), nitrogen (N) and oxygen (0), and/or, the crystalline mother material partially having amorphous parts;

amorphising said crystalline mother material, and

re-crystallizing said amorphisated mother material.

8. (Amended) The method of producing an anisotropic exchange spring magnet powder according to Claim 5 wherein in said crystallizing process, anisotropy is imparted to the crystalline mother material amorphisated in said amorphisating process and the material is molded while solidifying.

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9. (Amended) The method of producing an anisotropic exchange spring magnet powder according to Claim 5 wherein said amorphising process is conducted under a condition in which oxygen is blocked, in any of vacuum, an inert gas, nitrogen and an organic solvent.

13. (Amended) An anisotropic exchange spring magnet obtained by compression-molding process under a condition in which crystallization direction are arranged to the constant direction in magnet field, of an anisotropic exchange spring m agent powder comprising a hard magnetic material phase containing a rare earth metal element, a transition metal element, and at least one element selected from the group consisting of boron (B), carbon (C), nitrogen (N) and oxygen (O), and a soft magnetic material phase containing a transition metal element, and at least one element selected from the group consisting of boron (B), carbon (C), nitrogen (N) and oxygen (O), wherein said hard magnetic material phase and soft magnetic material phase have crystal particle diameters of 150 nm or less, and wherein the content of said rare earth metal element is from 2 to 15 atomic %, and the content of at least one element selected from the group consisting of boron (B), carbon (C), nitrogen (N) and oxygen (O) is from 1 to 25 atomic %.

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REMARKS

The Official Action of September 27, 2002 has been carefully considered. Accordingly, the amendments presented herewith for the application, taken with the following remarks, are believed sufficient to place the application in condition for allowance.

In paragraph 1 of the action, the Examiner has maintained the restriction requirement of claims 1-13, and that claims 5-12 now stand withdrawn from further consideration.

With respect to paragraph 2 of the action, and Applicants' statement on page 17 to incorporate the subject matter of the Japanese priority application, this sentence is now cancelled.

With respect to the objection in paragraph 3 of the action, claim 3 is now made an independent claim. This should overcome this objection.

In paragraph 5, claims 1-4 and 13 are rejected on the ground that the claims are not enabled under 35 USC 112, first paragraph. In response, the Examiner will note that by this Amendment, the term "amorphousating" is corrected to "amorphising" and "amorphousated" to "amorphisated". The changes correct obvious translation errors. In addition, the specification is amended at the paragraph beginning at page 8, line 30 and in the paragraph beginning at page 9, line 14, to clarify the Examiner's objection. On page 8, an amendment is made to state that the heat treatment is applied to enter the amorphous matrix which is crystalline mother material and the crystallization process is carried out by the ball mill method. Neither of these phrases introduce new matter. There is substantial discussion in the specification with respect to how these processes

are conducted and the results obtained. In particular, as noted by the Examiner, introduction of amorphous parts into a crystalline mother material can be carried out by known technologies. They are referred to as high frequency introduction melting, casting methods, liquid quenching methods, atomizing methods and the like. As pointed out at page 8, beginning at line 23, the amorphising process can be conducted by a ball mill method, plasma irradiation and the like, all of which are well known in the art. In the specification and including the examples, specific procedures for both the amorphising and the crystallizing method are set forth. Therefore, it is submitted that the invention as disclosed is clearly enabled under 35 USC 112.

In these amendments to the specification, Applicant has clarified this language to state that the heat treatment is applied to enter the amorphous form and that the crystallized matrix partly changes into amorphous parts by mechanical energy generated by the ball mill method in the second procedure, especially the re-amorphisation process. Further, Applicants assert that the amended terms amorphising, amorphisated and amorphisation are technical terms in the field of material science and/or condensed matter physics which is well known to those of skill in the art. For example, amorphisation is the reverse process of crystallization. Therefore, reconsideration of this rejection is requested.

In paragraph 7, claim 13 is rejected as indefinite on the ground that the meaning of the phrase "obtained by treatment" is not clear. By this amendment, claim 13 is amended to clarify the reference to the anisotropy-imparting molding process so that this objection is now believed overcome. Accordingly, reconsideration is requested.

In the action, paragraph 9, claims 1-4 and 13 were rejected under 35 USC 102(e) as anticipated by Nomura U.S. Patent 6,261,385. The Examiner relies on Nomura as teaching an aniostopic nanocomposite rare earth permanent magnetic consisting of a hard magnetic phase and a soft magnetic phase. The Examiner concludes that all elements of Applicants' claims are met by this reference. This rejection is also respectfully traversed and reconsideration is requested.

With respect to the rejection of claims 1-3, and 13 as being anticipated by the Namura et al. document (USP 6,261,385), Applicant respectfully traverses this rjeection because the Nomura document fails to disclose or teach every element of Applicant's amended claims 1-3, and 13, that is, the content of said rare earth metal element is from 2 to 15 atomic %, and the content of at least one element selected from the group consisting of boron (B), carbon (C), nitrogen (N) and oxygen (O) is from 1 to 25 atomic %.

Further, Applicant's invention as recited in amended claim 1 is directed to an anisotropic exchange spring magnet powder. The anisotropic exchange magnet powder includes a hard magnetic material phase containing a rare earth metal element; and a transition metal element, and at least one element selected from the group consisting of boron (B), carbon (C), nitrogen (N) and oxygen (O); and a soft magnetic material phase containing a transition metal element, and at least one element selected from the group consisting of boron (B), carbon (C), nitrogen (N) and oxygen (O). Further, in amended claim 1, the hard magnetic material phase and soft magnetic material phase have crystal particle diameters of 150 nm or less, and the content of the rare earth metal element is from 2 to 15 atomic %, and the content of at least one element selected from the group consisting of boron (B), carbon (C), nitrogen (N) and oxygen is from 1 to 25 atomic %.

An essential feature of the present invention is the numerical limitation of an atomic occupation ratio of the elements (rare earth metal element and at least one element selected from the group consisting of boron (B), carbon (C), nitrogen (N) and oxygen (O)).

In contrast, the Nomura patent discloses a magnetically anisotropic rare earth-based permanent magnet comprising a nanocomposite structure consisting of a hard magnetic phase and a soft magnetic phase finely and uniformly dispersed in each other in a volume ratio in the range from 10:90 to 90:10, particles of the hard magnetic phase being aligned in a direction relative to the easy magnetization axes of the particles. For instance, Nomura et al. disclose that the hard magnetic phase has a chemical composition of the formula Sm_2Co_{17} or $Sm_2(Fe, CO)_{17}$ and the soft magnetic phase is cobalt or a Fe-Co alloy.

As a result, Nomura et al. fail to disclose or teach the claimed ratio of elements, that is the content of the rare earth metal element in the claims of from 2 to 1 atomic %, and the content of at least one element selected from the group consisting of boron (B), carbon (C), nitrogen (N) and oxygen (O) is from 1 to 25 atomic %.

Applicant submits that an atomic occupation ratio of elements in amended claim 1 is physically quite different from a volume ratio of phases disclosed by Nomura et al. Accordingly, Applicant submits that the amended claim 1 is allowable. By the same reason, Applicant submits that the amended claims 3 and 13 are allowable.

It is believed that the above represents a complete response to the Official Action and reconsideration is requested.

Attached hereto is a marked-up version of the changes made to the specification and the claims by the current amendment. The attached page is captioned "**VERSION WITH MARKINGS TO SHOW CHANGES MADE**".

To the extent necessary, a petition for an extension of time under 37 C.F.R. 1.136 is hereby made. Please charge any shortage in fees due in connection with the filing of this paper, including extension of time fees, to Deposit Account 500417 and please credit any excess fees to such deposit account.

Respectfully submitted,

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VERSION WITH MARKINGS TO SHOW CHANGES MADE

Please amend lines 7-12 on page 2 as follows:

The present inventors have intensively investigated to attain the above-mentioned object, and resultantly, found that the above-mentioned object can be accomplished by treating a given crystalline mother material in specific [amorphousating] amorphising process and crystallizing process, leading to completion of the present invention.

Please amend lines 24-35 on beginning on page 2 to line 1 on page 3, as follows:

The method of producing an anisotropic exchange spring magnet powder of the present invention comprises: preparing a crystalline mother material containing a hard magnetic material phase containing a rare earth metal element, a transition metal element, and at least one element selected from the group consisting of boron (B), carbon (C), nitrogen (N) and oxygen (O), and/or, the crystalline mother material partially having amorphous parts: [amorphousating] amorphising the above-mentioned crystalline mother material, and re-crystallizing the above-mentioned [amorphousated] amorphisated mother material.

Please amend lines 6-10 on page 3 as follows:

When the production method of the present invention is effected, an anisotropic exchange spring magnet powder can be obtained which is finer and more excellent in magnetic property by repeating a continuous process composed of an [amorphousating] amorphising process and a crystallizing process.

Please amend lines 13-17 on page 5 as follows:

As element components, a [rear] rare earth metal element, a transition metal element, and boron (B), carbon (C), nitrogen (N) or oxygen (0) or any mixtures thereof

are contained, and a hard magnetic material phase and a soft magnetic material phase have crystal particle diameters of 150 nm or less.

Please amend lines 24-32 on page 7 as follows:

The method of producing an exchange spring magnetic powder of the present invention is a method for obtaining an exchange spring powder as described above, and in this method, a crystalline mother material containing the above-mentioned hard magnetic material phase and soft magnetic material phase, a material obtained by forming amorphous parts partially in this crystalline mother material, or a mixture of them, is subjected continuously to [amorphousating] amorphising treatment and crystallizing treatment each at least once.

Please amend lines 6-10 on page 8 as follows:

In the production method of the present invention, introduction of amorphous parts into such a crystalline mother material can be conducted by known technologies, f or example, a high frequency introduction [meeting] melting and casting method, liquid quenching method, atomizing method and the like.

Please amend lines 11-17 on page 8 as follows:

A benefit of thus introducing amorphous parts partially into a crystalline mother material previously is that oxidation of the mother material can be suppressed sufficiently since the following [amorphousating] amorphising process can be simplified and shortened, and by this [merit] means, the magnetic property of the resulting exchange spring magnetic powder can be further improved.

Please amend lines 23-29 on page 8 as follows:

The above-mentioned [amorphousating] amorphising process ran be conducted by applying a ball mill method, plasma irradiation method and the like, and by this process, a crystalline mother material and/or a material obtained by introducing amorphous parts into this crystalline mother material is [amorphousated] amorphisated into a condition in which fine crystal particles remain in an amorphous matrix.

Please amend lines 30-35 on page 8 through lines 1-4 on page 9 as follows:

In the production method of the present invention, a crystallizing process by heat treatment is conducted following this [amorphousating] amorphising process[,]. The heat treatment is applied to enter the amorphous matrix, which is crystalline mother material to partially introduce the amorphous parts. [and]by By this process, crystal particles in the above-mentioned amorphous matrix are crystallized so finely as to cause exchange connection of the particles, and in this procedure, crystals grow continuously toward the direction of fine crystal particles remaining, resultantly, in one crystal particle, an anisotropic exchange spring magnet powder which is fine and has crystal particle diameters of approximately the same size is formed.

Please amend lines 5-13 on page 9 as follows:

In the production method of the present invention, the above-mentioned [amorphousating] amorphising process and/or crystallizing process is desirably conducted under a condition in which oxygen is blocked, for example, in vacuum, in an inert gas, in nitrogen or in an organic solvent. By conducting the process under such a condition, deterioration of a rare earth metal-based magnetic compound can be prevented, and decrease in magnetic property of the resulting exchange spring magnetic powder can be prevented.

Please amend lines 14-20, on page 9 as follows:

Further, in the production method of the present invention, it is desirable to repeat the above-mentioned [amorphousating] amorphising process and crystallizing process (continuous process of [amorphism] amorphisation-crystallization) once or more times[,]. Namely, after the above-crystallizing process of the first time, a crystallized matrix (crystal) is conducted by the ball mill method. In details, in the second time procedure, the crystallized matrix partly changes into amorphous parts by mechanical energy generated by the ball mill method. [and by] By this, the degree of orientation of crystal is further improved, and consequently, an anisotropy-imparting effect increases, which is effective for improvement of magnetic property.

Please amend lines 21-32 on page 11 as follows:

A crystalline mother material containing amorphous parts was produced according to a liquid quenching method using an alloy of the formula: $Nd_4Fe_{88-x}Co_5Nb_3B_x$, which had been high frequency induction-fused. Then, this crystalline mother material was ground into a coarse powder of 1 mm or less which was [amorphousated] amorphised by a plasma irradiation method, then, crystallizing treatment was conducted for given cycles to obtain an anisotropic exchange spring magnet powder of this embodiment. In this magnetic powder, a hard magnetic material phase: $Nd2Fe_{14}B$ had a crystal particle diameter of about 40 nm, and a soft magnetic material phase: Fe_3B had a crystal particle diameter of about 40 nm.

Please amend lines 33-35 on page 11 to line 1, page 12, as follows:

In this plasma irradiation method, the above-mentioned coarse powder was exposed in high frequency Argon (Ar) plasma, and this coarse powder was [amorphousated] amorphised from the surface direction by plasma energy.

Please amend lines 25-29 on page 12, as follows:

Fig. 2 shows the relative value of coercive force of the same material as in Fig. 1. It is apparent that coercive force is important as magnetic property can not be obtained in the form of mother material, and is improved by conducting amorphism and crystallization each once or more times.

Please amend lines 14-21 on page 14 as follows:

A crytalline mother material containing amorphous parts was produced according to a liquid quenching method using an alloy of the formula: $Nd_xFe_{84-x}Co_8V_2B_6$ which had been subject to high frequency induction [meeting] melting and casting, and this mother material was placed in a stainless steel ball mill pot together with stainless steel balls using cyclohexane as a solvent, and [amorphousating] amorphising treatment was conducted according to a ball mill method.

Please amend lines 28-35 on page 14 as follows:

The [resulted] powder was ground into a powder of 100 μm or less, then, press-molded in a magnetic field of 25kOe (1990kA/m) to produce a compressed powder body, and magnetization curves along magnetic field application direction and vertical direction [to this] of the powder body were measured by a direct current BH tracer manifesting a maximum field of 25kOe (1990kA/m), and presence or absence of anisotropy was confirmed by a difference between these curves.

Please amend lines 8-12 on page 15 as follows:

It is known that the effect of the process of the present invention is extremely high, and anisotropy can be imparted by practicing once. Further, there is also shown a tendency [of] for an increase [in extent] of anisotropy by repetition of once or more times.

Please amend lines 15-18 on page 15 as follows:

It is apparent that coercive force is important as magnetic property can not be obtained in the form of mother material, and is improved by conducting amorphism and crystallization each once or more times.

Please amend lines 29-32 on page 15 as follows:

The effect of this process is extremely large, and it is known that anisotropy can be imparted by practicing once. Further, there is also shown a tendency of an increase in [extent of] anisotropy by repetition [of] once or more times.

Please amend line 35 on page 15 through lines 1-3 on page 16 as follows:

It is apparent that coercive force is important as magnetic property can not be obtained in the form of mother material, and is improved by conducting amorphism and crystallization each once or more times.

Please amend lines 15-21 on page 16 as follows:

Regarding composition range, it is known that higher property [over] above that of conventional magnetic materials is obtained when the atomic % is f rom 2 to 15. Further, the same effect and high ability could be realized also when Nd-Pr, Pr, Nd-Dy

(dysprosium) and the like were used as a rare earth metal element for a rare earth metal element Nd, and these data are illustrated together.

Please amend lines 31-35 on page 16 as follows:

It is known that the extent of anisotropy further increases in a magnetic field when sintering is conducted after molding [in magnetic field] as compared with the case of heat treatment in vacuum as a crystallizing process.

Please amend lines 8-24 on page 17 as follows:

As described above, according to the present invention, since a given crystalline mother material is treated in an [amorphousating] amorphising process and a crystallizing process, an exchange spring magnet having excellent anisotropy and high maximum energy product can be realized. Namely, the production method of the present invention is a production method providing an anisotropic exchange spring magnet having excellent magnetic ability, and an anisotropic exchange spring magnet powder obtained from this magnet can realize a bond magnet and full dense magnet having high ability which have not been obtained from conventional isotropic magnetic powders, therefore, when the anisotropic exchange spring magnet of the present invention is applied to motors, magnetic sensors, rotation sensors, acceleration sensors, torque sensors and the like using magnets, production of smaller and lighter products is promoted, and when this magnet is applied to automobile parts, remarkable improvement in fuel consumption is possible.

Please delete lines 25-27 on page 17.

IN THE CLAIMS:

Please amend the claims as follows and cancel claim 2.

1. (Amended) An anisotropic exchange spring magnet powder comprising:

a hard magnetic material phase containing [a] at least one rare earth metal element, a transition metal element, and at least one element selected from the group consisting of boron (B), carbon (C), nitrogen (N) and oxygen (O); and

a soft magnetic material phase containing a transition metal element, and at least one element selected from the group consisting of boron (B), carbon (C), nitrogen (NO and oxygen (O), [and] wherein

said hard magnetic material phase and soft magnetic material phase have crystal particle diameters of 150 nm or less[.] , and wherein

the content of said rare earth metal element is from 2 to 15 atomic %, and the content of at least one element selected from the group consisting of boron (B), carbon (C), nitrogen (N) and oxygen (O) is from 1 to 25 atomic %.

3. (Amended) [The] An anisotropic exchange spring magnet powder [according to Claim 1,] comprising:

a hard magnetic material phase containing [wherein said] at least one rare earth metal element [rare earth metal element is at least one element] selected from the group consisting of neodymium (Nd), praseodymium (Pr) and samarium (Sm), a transition metal element, and at least one element selected from the group consisting of boron (B), carbon (C), nitrogen (N) and oxygen (O); and

a soft magnetic material phase containing a transition metal element, and at least one element selected from the group consisting of boron (B), carbon (C), nitrogen (N) and oxygen (O), and wherein

said hard magnetic material phase and soft magnetic material phase have crystal particle diameters of 150 nm or less[.] and wherein

the content of said rare earth metal element is from 2 to 15 atomic %, and the content of at least one element selected from the group consisting of boron (B), carbon (C), nitrogen (N) and oxygen (O) is from 1 to 25 atomic %.

5. (Amended) A method of producing an anisotropic exchange spring magnet powder comprising steps of: preparing a crystalline mother material containing a hard magnetic material phase containing a rare earth metal element, a transition metal element, and at least one element selected from the group consisting of boron (B), carbon (C), nitrogen (N) and oxygen (0), and a soft magnetic material phase containing a transition metal element, and at least one element selected from the group consisting of boron (B), carbon (C), nitrogen (N) and oxygen (0), and/or, the crystalline mother material partially having amorphous parts;

[amorphousating] amorphising said crystalline mother material, and

re-crystallizing said [amorphousated] amorphisated mother material.

8. (Amended) The method of producing an anisotropic exchange spring magnet powder according to Claim 5 wherein in said crystallizing process, anisotropy is imparted to the crystalline mother material [amorphousated] amorphisated in said [amorphousating] amorphisating process and the material is molded while solidifying.

9. (Amended) The method of producing an anisotropic exchange spring magnet powder according to Claim 5 wherein said [amorphousating] amorphising process is conducted under a condition in which oxygen is blocked, in any of vacuum, an inert gas, nitrogen and an organic solvent.

13. (Amended) An anisotropic exchange spring magnet obtained by [treatment, in an anisotropy-imparting molding process and a solidification process] compression-molding process under a condition in which crystallization direction are arranged to the constant direction in magnet field, of an anisotropic exchange spring m agent powder comprising a hard magnetic material phase containing a rare earth metal element, a transition metal element, and at least one element selected from the group consisting of boron (B), carbon (C), nitrogen (N) and oxygen (O), and a soft magnetic material phase containing a transition metal element, and at least one element selected from the group consisting of boron (B), carbon (C), nitrogen (N) and oxygen (O), wherein said hard magnetic material phase and soft magnetic material phase have crystal particle diameters of 150 nm or less, and wherein the content of said rare earth metal element is from 2 to 15 atomic %, and the content of at least one element selected from the group consisting of boron (B), carbon (C), nitrogen (N) and oxygen (O) is from 1 to 25 atomic %.